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SPECIFICATION FOR ELECTROPLATED COATINGS OF COPPER

(First Revision)

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NEW DELHI 110002

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SPECIFICATION FOR ELECTROPLATED COATINGS OF COPPER

(First Revision)

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Indian Standard
SPECIFICATION FOR ELECTROPLATED COATINGS OF COPPER
(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 25 January 1973, after the draft finalized by the Metallic Finishes Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This standard was earlier published in 1961. On the basis of the experience gained during these years, it was felt that coating requirements as specified in the standard need to be modified. In this revision, the requirements of coating thicknesses for the three grades covered earlier have been modified and also one more grade has been introduced to cover applications where copper plating is used to provide for anti-seizure services or to minimize fretting corrosion of mating surfaces.

0.2.1 For determination of thickness, eddy current method described in IS : 6012-1970* has been specified as an alternate method. Besides, a clause on corrosion resistance has been included.

0.3 This standard contains clauses **2.1**, **3.1** (Note), **4.1** and **4.3** which call for agreement between the supplier and the purchaser.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960†. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard specifies requirements for electroplated coatings of copper on ferrous and non-ferrous metals and alloys.

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*Method for measurement of coating thickness by eddy current.

†Rules for rounding off numerical values (*revised*).

2. DEFINITION

2.0 For the purpose of this standard, the following definition shall apply.

2.1 Significant Surface — The part of the surface which is essential to the appearance or serviceability of the article and which is to be covered, or is covered, by the coating. When necessary the significant surface should be the subject of agreement between the supplier and the purchaser, and should be indicated on drawings or by provision of suitably marked samples.

NOTE — Generally, significant surfaces are defined as those parts of the visible surface that may be touched with a sphere of 20 mm diameter.

3. CLASSIFICATION

3.1 Grading of Service Conditions — The service condition grade indicates severity of the service:

Grade	*Service Condition*	*Application*
4	Exceptionally severe	For applications, such as stop-off during selective case-hardening.
3	Severe	For applications, such as a shield during heat treatment processes.
2	Moderate	For applications where corrosion resistance of steel surfaces is required and also where conductivity on ferrous and non-ferrous surfaces is to be provided.
1	Mild	To provide anti-seizure surfaces and to minimize fretting corrosion.

NOTE — Choice of the service condition number corresponding to the use of the part to be plated should be the subject of agreement between the purchaser and the supplier.

3.2 Classification of Coating — The classification number of coating shall comprise:

a) chemical symbol Fe for steel basis metal or letter 'N' for non-ferrous basis metal,

b) chemical symbol Cu for copper coating, and

c) a number indicating the minimum thickness (in micrometres) of copper coating.

4. COATING REQUIREMENTS

4.1 Appearance — Over the significant surface the plated article shall be free from clearly visible plating defects, such as blisters, pits, roughness, cracks or unplated areas. The extent to which blisters may be tolerated on non-significant surfaces shall be the subject of agreement between the supplier and the purchaser. On articles where a contact mark is inevitable, its position shall also be the subject of agreement between the supplier and the purchaser.

4.2 Thickness — The minimum thickness on all significant surfaces, for the appropriate service condition grade, shall be as specified in Table 1.

TABLE 1 THICKNESS OF COPPER PLATING

GRADE	CLASSIFICATION NUMBER		MINIMUM THICKNESS OF COATING
	Steel Basis Metal	Non-ferrous Basis Metal	µm
4	FeCu50	—	50
3	FeCu20	—	20
2	FeCu15	NCu15	15
1	FeCu5	NCu5	5

NOTE — For better protection against corrosion under humid conditions, these coatings shall be suitably lacquered. The lacquers shall conform to IS : 342-1952*.

*Specification for varnish, acid resisting, (a) clear, and (b) tinted.

4.3 Adhesion — Copper plating on articles used for service condition grades 4 and 3 shall be subjected to the tests given in **7.2.1** and the copper plating on articles used for service condition grades 2 and 1 shall be subjected to the either of the tests given in **7.2.2** and **7.2.3** as agreed to between the supplier and the purchaser. The coating thus tested shall meet the requirement specified in the relevant tests.

4.4 Continuity of Coating — This test shall apply only to copper coatings for service condition grade 4. The coating, when tested in accordance with the method specified in **7.3**, shall show no blue spots indicating porosity in the coating.

4.5 Corrosion Resistance — Copper plated articles used for service condition grade 2 shall be subjected to the test specified in IS : 5528-1969* for a period of 6 hours. The performance of coating shall be evaluated according to IS : 6009-1970* and the rating number shall not be less than 6.

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*Method of testing corrosion resistance of electroplated and anodized aluminium coatings by copper-accelerated acetic acid salt spray (CASS) test.

NOTE 1 — Any lacquer coating applied over the copper plating shall be removed before the surface is subjected to this test.

NOTE 2 — When ordering articles to be plated in accordance with this standard the purchaser should state in addition to the number of the standard, either the service condition grade denoting the severity of the condition, the coating is required to withstand (*see* **3.1**), or the classification number of the particular coating required (*see* **3.2**). The purchaser should also indicate any heat treatment required before and after plating (*see* **5.1**).

5. HEAT TREATMENT OF STEEL

5.1 When required by the purchaser, heat treatment as described in Appendix A should be performed on certain steels to reduce the risk of damage by hydrogen embrittlement.

6. SAMPLING

6.1 Lot — A lot shall consist of the articles, parts or components, approximately of the same size, shape and electroplated at one time in the same bath.

6.1.1 For the purpose of acceptance, a lot shall be divided into sub-lots of 100 articles or part thereof. Samples shall be taken from each sub-lot for ascertaining the conformity of the sub-lot to the specified requirements.

6.2 Criteria for Acceptance — If these samples pass the tests, the sub-lot represented by them shall be accepted. If one or both the samples should fail, two further samples shall be selected from the same sub-lot and subjected to the tests. If these samples pass the tests, the sub-lot shall be accepted. If any of the second set of samples fails in any test, the sub-lot shall be rejected.

6.3 Separate Specimen — When plated articles cannot be subjected to any of the specified tests, two specimen of the same basis metal conforming in size and shape of the article as far as possible should be plated along with the article under identical conditions for the purpose of testing.

7. TESTS

7.1 Thickness — The thickness of coating shall be determined by any of the methods specified in IS : 3203-1965† or IS : 6012-1970‡.

7.2 Adhesion

7.2.1 *Baking Test* — The specimen shall be heated to a temperature between 310 to 315°C for 3 hours. The coating shall not show any blisters or similar defects.

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*Method for evaluation of results of accelerated corrosion tests.

†Methods of testing local thickness of electroplated coatings.

‡Method for measurement of coating thickness by eddy current.

7.2.2 *Bend Test* — Place the sample in a bend tester with 4 mm radius of bending. Bend the sample as far as 90° forward and backward, successive bends being made in opposite directions. For the purpose of this test, one bend shall constitute bending forward to 90°C and back to original position. The sample shall stand three such bends without flaking.

7.2.3 *Burnishing Test* — Rub an area not more than 6 cm^2 of the significant surface, rapidly and firmly for 30 seconds with a smooth metal implement. Employ a pressure sufficient to burnish the coating metal at every stroke, but not so great as to cut the coating. Poor adhesion is shown by the appearance of a loose blister which grows as rubbing is continued. If the quality of the deposit is also poor, the blister may crack and the plating will peel away from the basis metal. More than one area may be tested if desired.

7.3 Test for Continuity

7.3.1 *Ferroxyl Test* — Coat a piece of absorbent paper uniformly with a warm solution of gelatin (about 0·5 g/l) and allow to dry.

7.3.1.1 Moisten the paper with 30 g/l sodium chloride solution and lay it over the surface to be tested. Periodically moisten the paper with the sodium chloride solution. Remove the paper after 10 minutes and immerse in a solution of potassium ferricyanide (10 g/l). Blue spots on paper indicate porosity on the coating.

8. MARKING

8.1 Copper plated articles, which relate only to the coating and not to the quality of the article, shall be marked with service condition grade or classification number and the name or trade-mark of the manufacturer.

8.1.1 The plated articles may also be marked with the ISI Certification Mark.

NOTE — The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

APPENDIX A

(*Clause* 5.1)

HEAT TREATMENT OF STEEL

A-1. STRESS RELIEF BEFORE PLATING

A-1.1 Severely cold-worked steel parts or parts made from steel of tensile strength of 100 kgf/mm^2 (or corresponding hardness*) or above, which have been ground or subjected to severe machining after tempering, should normally be stress-relieved. As a guide, they may be maintained at the highest temperature within the limit imposed by the tempering temperature for 30 minutes, or maintained at a temperature of 190 to 210°C for not less than 1 hour.

A-1.1.1 Some steels which have been carburized, flame-hardened or induction-hardened and subsequently ground, would be impaired by the above treatment and should instead be stress-relieved at a lower temperature; for example at 170°C for not less than 1 hour.

A-2. DE-EMBRITTLEMENT TREATMENT AFTER PLATING

A-2.1 Components subject to fatigue or sustained loading stresses in service and made from severely cold-worked steels or from steels of tensile strength 100 kgf/mm^2 (or corresponding hardness*) or above, and that are not to be subsequently case-hardened, heat-treated or brazed, should be subjected to de-embrittlement treatment. A guidance is given in Table 2.

A-2.1.1 Where the proposed temperature would be harmful, for example, for some surface-hardened parts, a lower temperature for a longer time may be required.

TABLE 2 GUIDANCE ON HEAT TREATMENT OF STEEL PARTS AFTER PLATING

TENSILE STRENGTH kgf/mm^2	MAXIMUM SECTIONAL THICKNESS OF PART mm	MAXIMUM PERIOD AT 190 TO 210°C hours
100 to 115	Less than 12	2
	12 to 25	4
	Over 25	8
115 to 140	Less than 12	4
	12 to 25	12
	25 to 40	24. Heating to commence within 16 hours of plating
	Over 40	Requires experimental determination
Over 140	Requires experimental determination	Requires experimental determination

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*30 *HRC*, 295 *HV*, 280 *HB* (approximate values).

BUREAU OF INDIAN STANDARDS

Headquarters :

Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002

Telephones : 3 31 01 31, 3 31 13 75 Telegrams : Manaksanstha
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